Executive Summary

The Hilton Hotel at BWI Airport is a full-service hotel located less than two miles from the BWI Airport in Linthicum Heights, Maryland. The 277,000 sf building will cost about $27 million for design and construction. In the original mechanical systems design, all the equipment is served by a boiler and condenser water system. The ground and second floors of the building are served by four air handling units through a VAV system with hot water reheat coils at the boxes. The third through eleventh floors have 279 guest rooms with individual water source heat pumps. Five rooftop units provide 100% outdoor air to the guest room corridors, service areas, laundry rooms, and kitchen.

The goals and methods of research and design for this thesis project have changed significantly from the original thesis proposal. This is because many new ideas and methodologies have been developed since then.

The primary goal for this thesis project is to improve energy efficiency. Energy efficiency is beneficial because it saves energy, reduces the amount of resources used, decreases environmental impacts, and saves money. As a result of this, other objectives include reducing life cycle cots, promoting sustainability, design innovation, and indoor environmental quality improvement.

In order to achieve this goal of energy efficiency, the mechanical systems of the BWI Hilton need to be improved. This thesis report details the steps taken to improve the original design. The new mechanical systems for the BWI Hilton are based on a 700 ton central chilled water plant. The central plant is designed with two new centrifugal chillers operating in a variable primary flow system. The cooling towers for the building are also reduced from the original design. All the original systems in the building are replaced with equipment designed with chilled water coils, including the air handling units, rooftop units, dedicated outdoor air units, and fan coil units. Water-side free cooling is also studied and implemented to further increase the energy efficiency of the chilled water system.

This thesis report compares the energy consumption of the original design to the new design with the central chilled water plant. As is evident throughout the project, energy is saved in nearly every area, except for natural gas usage. However, the increase in natural gas consumption is offset by the much larger reduction in electric usage. Electric energy usage is reduced by 82%, but the natural gas consumption increases by 127%. However, the total energy costs for the BWI Hilton are reduced by 62%.

The new and more energy efficient design has a much lower operating cost than the original design and is more environmentally-friendly with reduced emissions by about 64%. Despite increasing the first costs by $685,000, the operating costs are decreased by $750,000, and a life cycle cost analysis yields a one year payback period and a net present worth savings of almost $8 million.